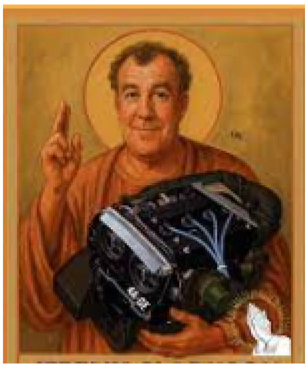
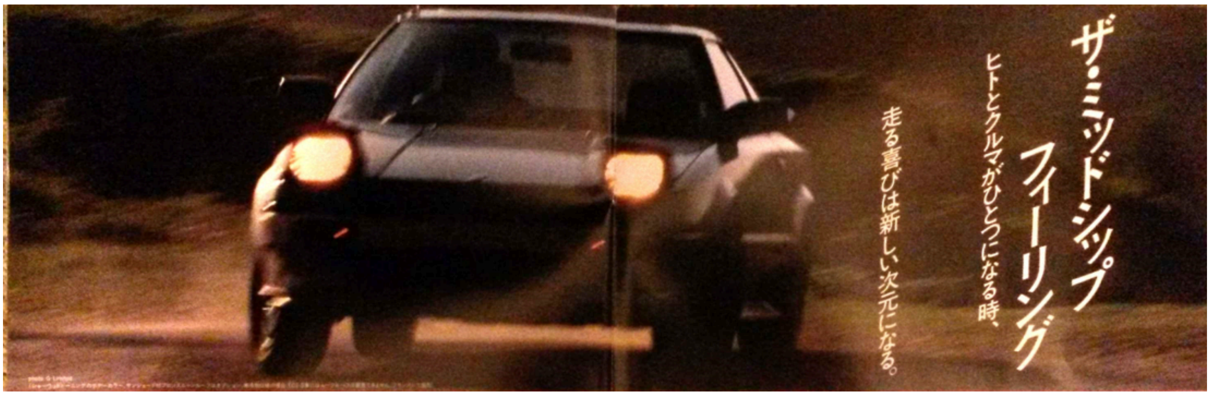
4A-GE BIBLE



This is a comprehensive guide to the legendary 4A-GE engine



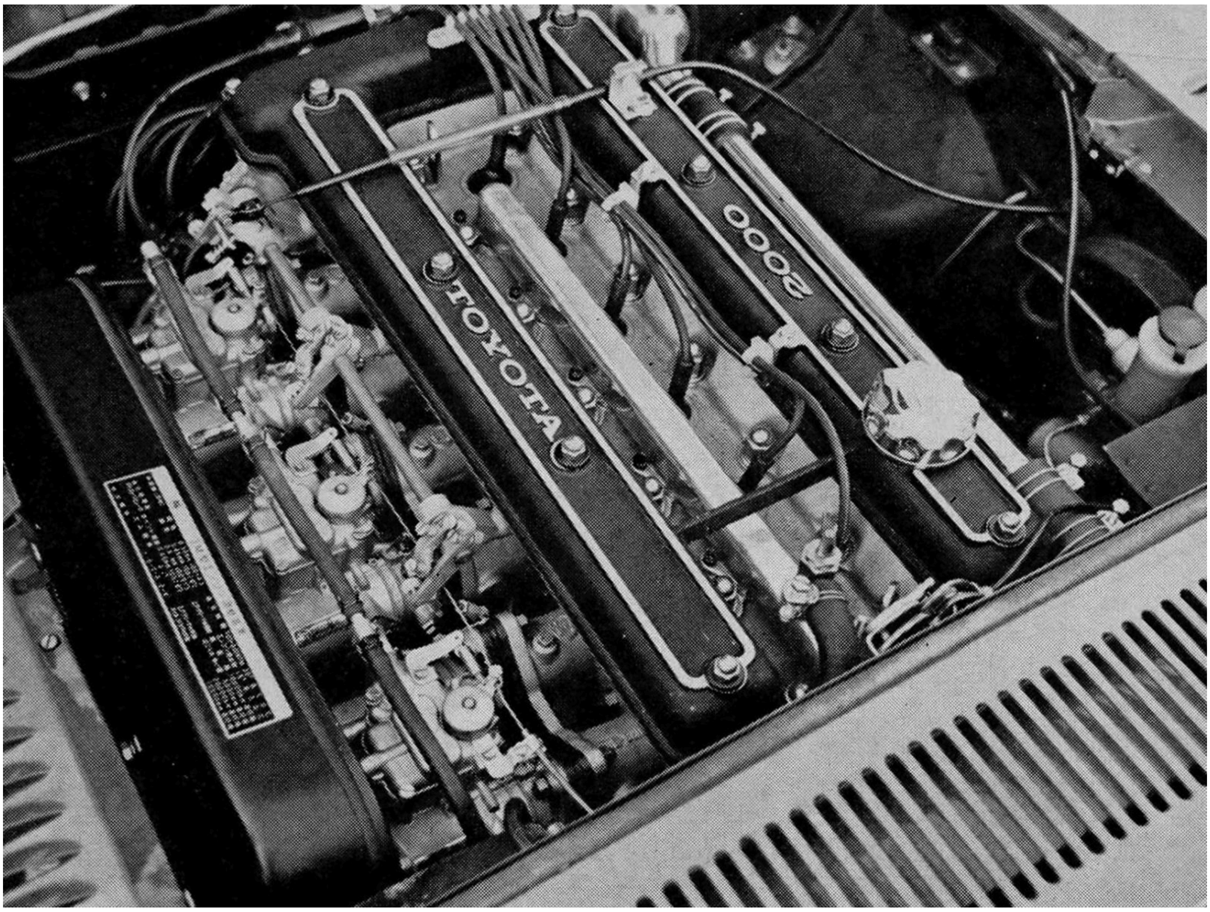
And factual archive of history & information

Disclaimer: Everything presented here was founded from years of research and aims to be as accurate as possible. If mistakes are found feel free to correct me- CB

How many engines have captured the hearts and minds of such a hardcore and knowledgeable group of enthusiasts like Toyotas 4AGE?

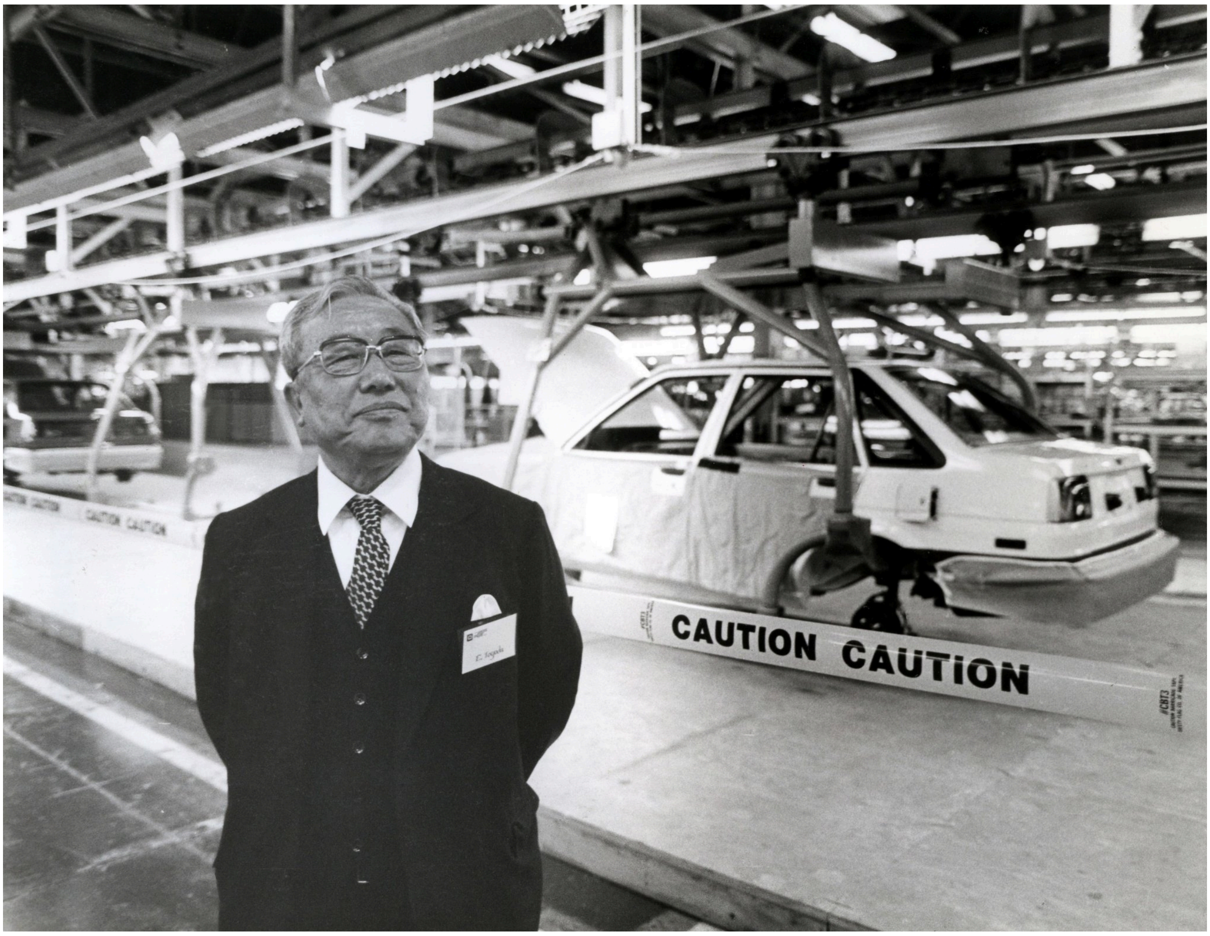
Introduced in 1983 and spanning a rich history to present day 2025, nobody could predict the following that Toyota’s little twincam would gain over the almost half century run.

Toyota's first DOHC sport-type engine was the 3M, which debuted in 1967 in the gorgeous 2000GT.

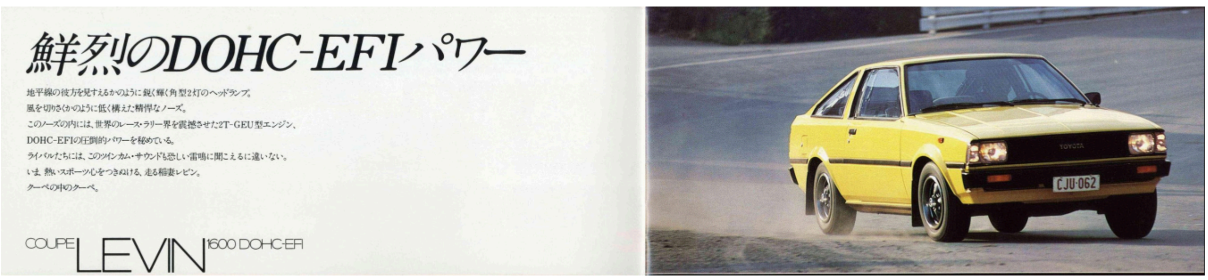


Since then, Toyota put a priority on double overhead cam engines being taken out of the realm of enthusiast only sports driving, and firmly set in the reach of production cars to be enjoyed by everyone

This was further supported by the esteemed corporation Yamaha, which at the time of the 2000GT were master engineers in airflow research and development. With decades of motorcycle building experience behind them, Yamaha had the skillset to produce high performance competitive cylinder heads (including an experimental 5 valve per cylinder head, more on this later) and Toyota had the industrial strength to capitalize on it.
This partnership spanned nearly half a century, and Yamaha and Toyota closely work together to this day on both production engines and the Toyota racing program.



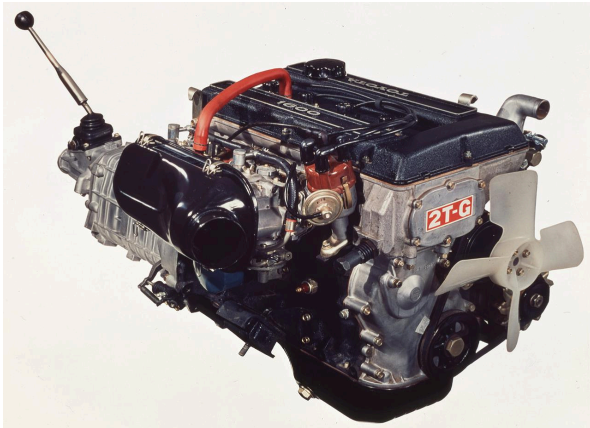
Eiji Toyoda, pictured next to a USDM AE82 corolla.



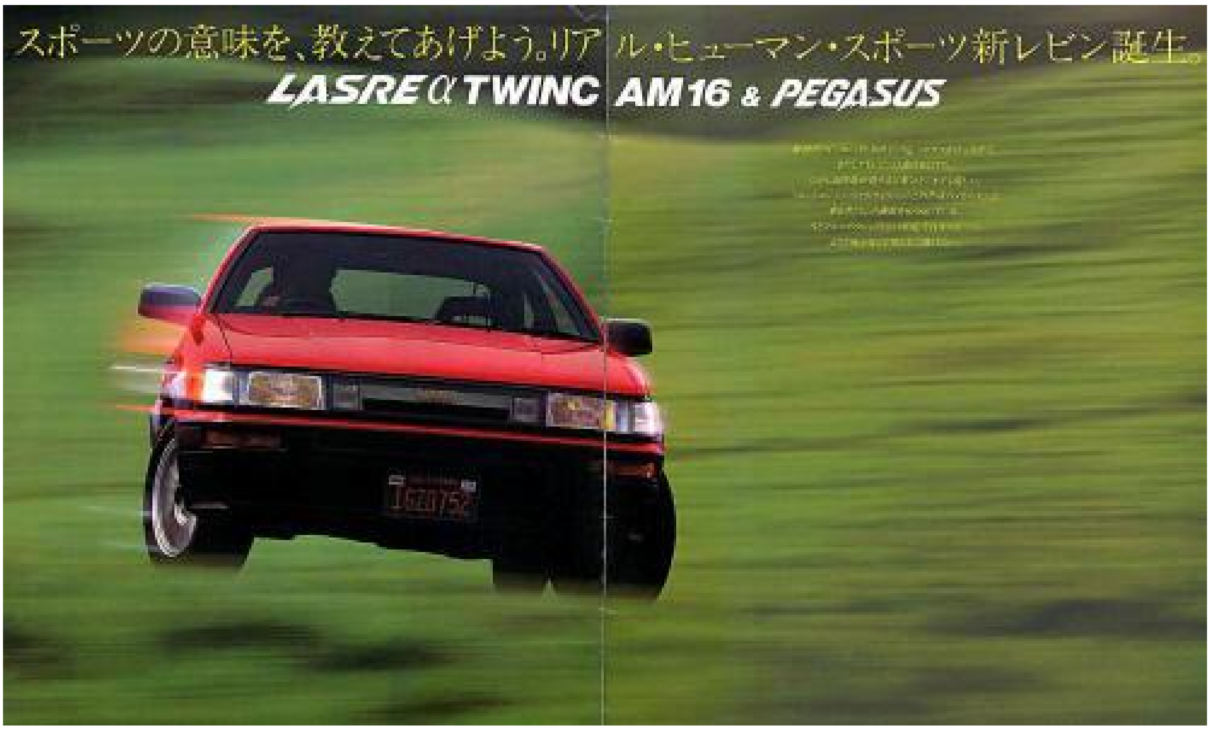
This engineering cooperation was used heavily through the 1970s, with a considerable accumulation of technology and know-how over the previous decade. Millions of yen were spent on R&D, this gave birth to the 2T-G and later 18R-G. These were very advanced engines for the time with high tunability, uncomplicated servicing with most iterations breathing through twin carburettors. But importantly they only possessed two valves per cylinder, and were all hand-built costing huge amounts to produce.

In 1982, the advancement of EFI (electronic fuel injection) in mass production Japanese cars became commonplace. Toyota saw this as an advantage to create a high-volume small displacement performance engine, that could be cost effective to produce, economical to run and mostly maintenance free.

At the time the only flavours available were from the aging T series designation. Yamaha were producing DOHC heads for the 1588cc 2T from 1970 all the way to 1983, and by then it was showing its age. While a proven workhorse in motorsports for the last decade, the 2T-G had a complex camshaft rocker system, poor oil drainage and the cam-chain drive suffered problems from tensioners failing under high RPM.



The logical progression was for Toyota to retire the T series and advance with a brand-new engine for the modern age…

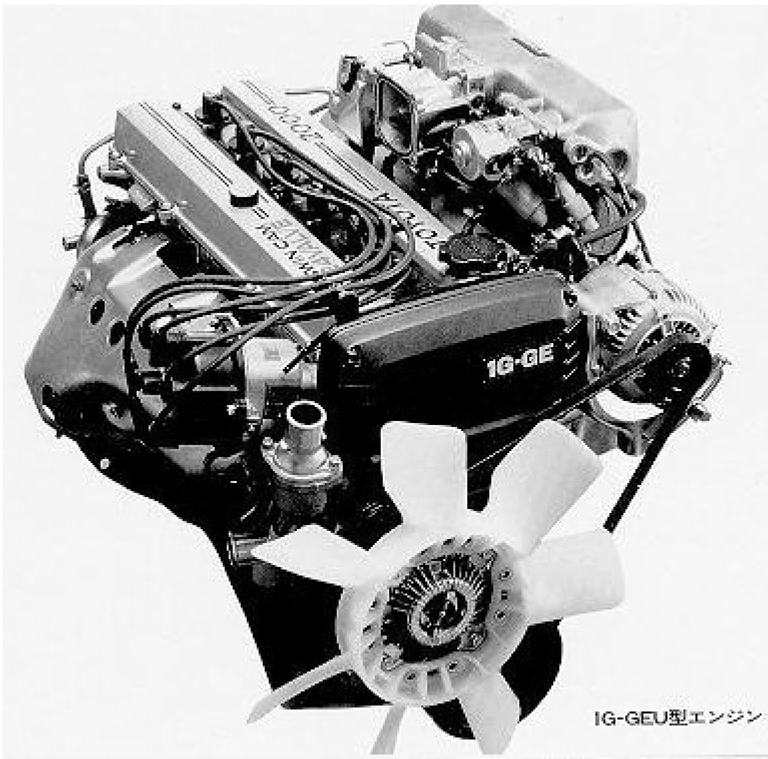


Surprisingly, we owe a lot of the 4A-GE development to the humble 2 Litre 1G six cylinder engine.

What started out as a low stressed economy focused engine, found in taxis and commercial vehicles alike, soon became the base for Toyotas modern 16 valve twin cam research.
Yamaha finalized the 1G-GE design in 1981, two years before the 4A-GE started production, and it gave birth to a whole new generation of mass production 16 valve engines- technology previously confined to the racetrack.

This development stirred the European crowd, as their DOHC 6 Cylinders commanded a premium price and prestige that was unfounded within the Japanese Toyota upstarts.

That soon rang true when the new modern twincams hit the showrooms at half the price of their German counterparts….



With both engines side by side, the similarities quickly become obvious.

The start of this new generation of modern 16 valves was dubbed the “**LASRE**” series. **L**ightweight **A**dvanced **S**uper **R**esponsive **E**ngine

Promising performance, efficiency and reliability in a lightweight package, these were all important targets to meet in an uncertain time of a long running oil crisis, and ever tightening emissions controls.

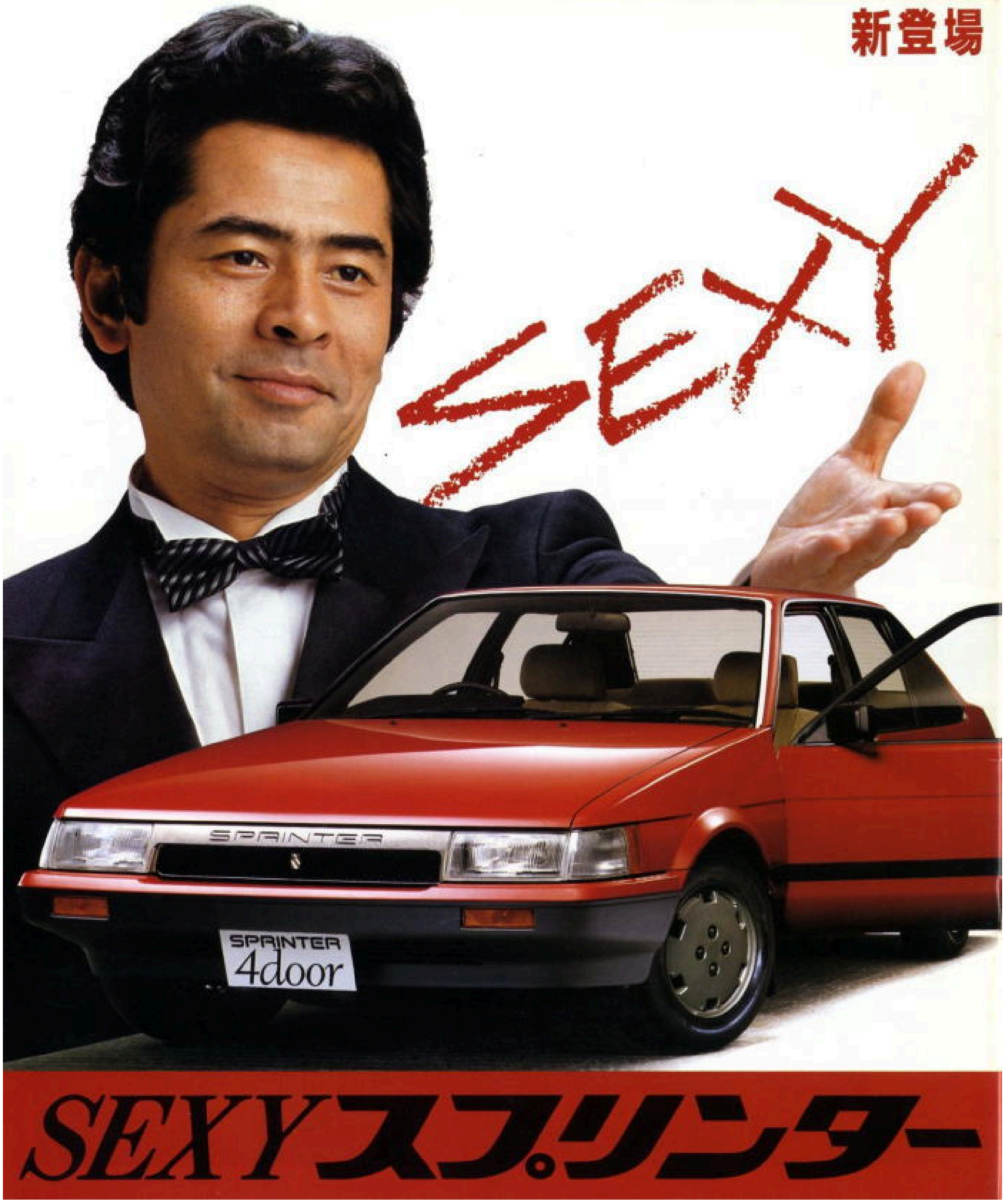
These engines were all modern multi-valve, belt driven and could pass stringent emissions tests fitted with catalytic converters.
In this gradual shift away from carburettor technology, Toyota placed priority on reliability and refinement. This is evident today, as the A series can easily achieve over 300,000km, and thousands are still alive and on the roads.

GENESIS

By 1983 the engine was starting production, finding a home in the recently released AE86 Corolla and AA63 Celica.

Toyota used the already proven “A” series engine design, of which the 4A-GE is a direct descendant. Production started in 1978, as a single overhead cam, belt driven economy focused engine ranging from 1.3 to 1.6 litre capacities.

No performance-based formula was conceived prior to the “G” series head configuration, and all but the final 1983 4A-ELU were Carbureted.



Sexy Corolla Sprinters

Toyota chose the A series for a number of reasons. I will summarize a few here:

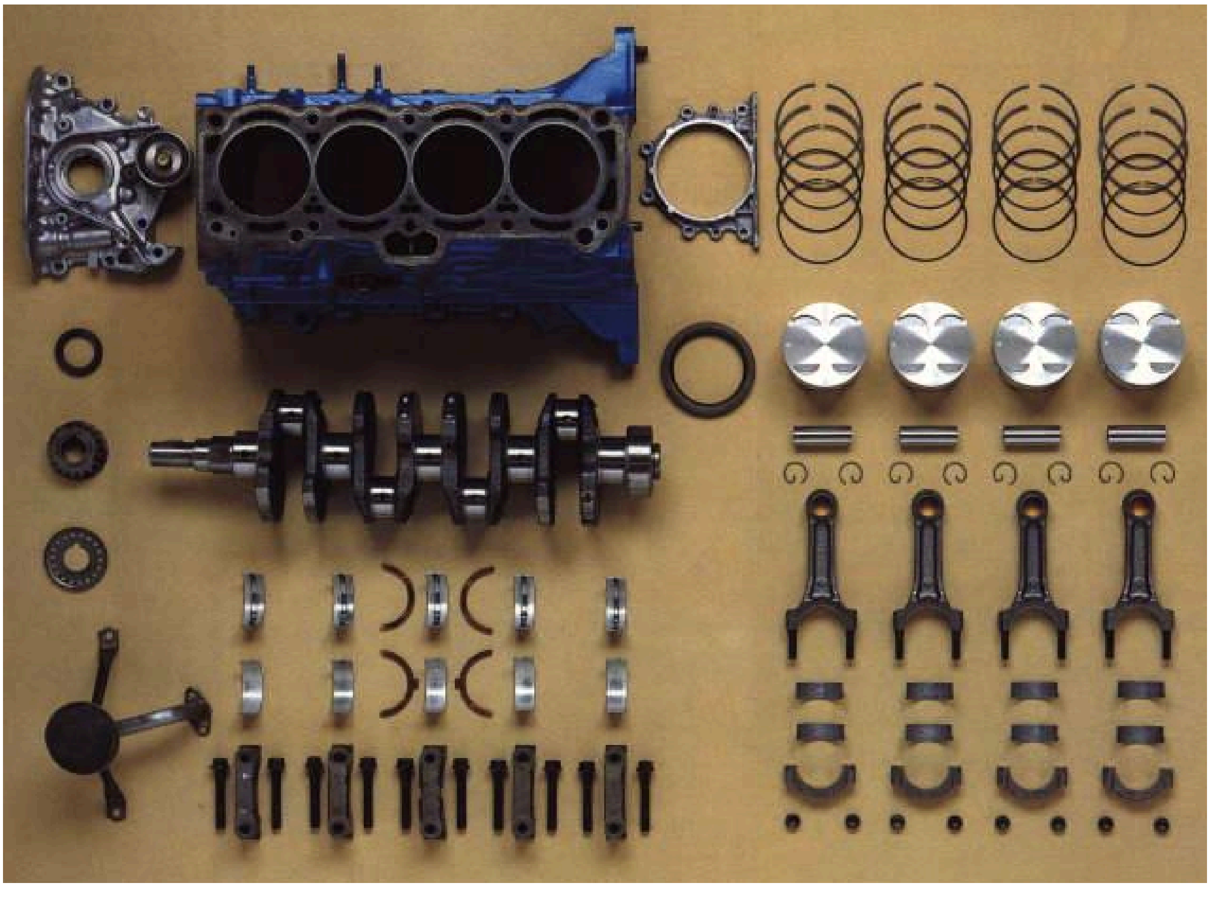
Weight- The cast iron blocks were relatively light for the standards of the day at around 40kg bare. (By comparison a recently released Nissan CA16 4 cylinder was almost 20kg heavier)

Cost- Since 1978 Toyota had been producing the A series. The casting and tooling was already in production long before the DOHC designation. This meant more money for R&D and less pre-production costs.

Size- The A series was already a compact design, with a narrow closed-deck block and a low deck height. As well as being configurable for both RWD and FWD applications, it made it an ideal powerplant for a variety of cars to be produced later down the line.

Simplicity- From the first iteration, the A series was a simple, serviceable design using a belt driven camshaft (though this was an idea stolen from the Italians with the then decade old Fiat Twin cam), a logically routed cooling system with no internal gaskets and used minimal special tools required for disassembly.

Strength- Although never designed for high performance, the A series is a sturdy cast iron design with thick cylinder bores, 5 main crank journal bearings and a high resistance to thermal expansion and cracking. It underwent five major variations, (more on this below).

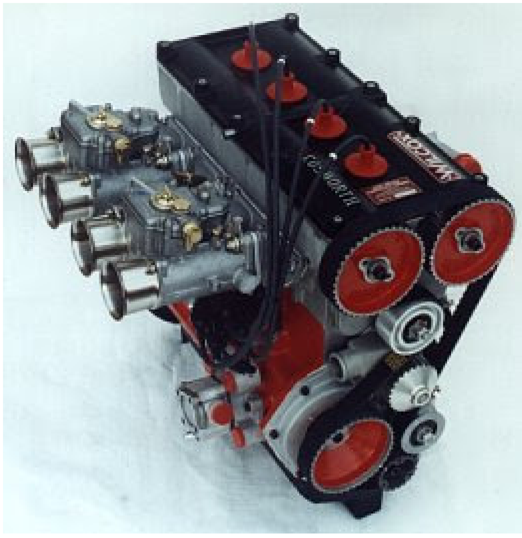


4AGE Mythbusters

Over the last 30 years, many stories and incorrect statements have been told about Toyotas famous twincam. Here, I will try to debunk a few.

“The 4AGE was a copy of Fords BDA Cosworth engine”

This is an easy comparison to make by a few facts.



The BDA Cosworth translates to Belt Driven A-series
The BDA Cosworth was designed 11 years prior
Both are 1587cc
Both share a bore and stroke of 81x77mm
Both are DOHC with a shim over bucket configuration

However the similarities stop there.

The Cosworth BDA was a race engine first, and production engine last. It used a complicated two piece head, lacked the metallurgy and strength of the 4A-GE block and used an older style block mounted distributor. While it's true Toyota could have gained some inspiration from the design, absolutely zero parts cross over between the two, meaning to call it a direct copy is **FALSE**

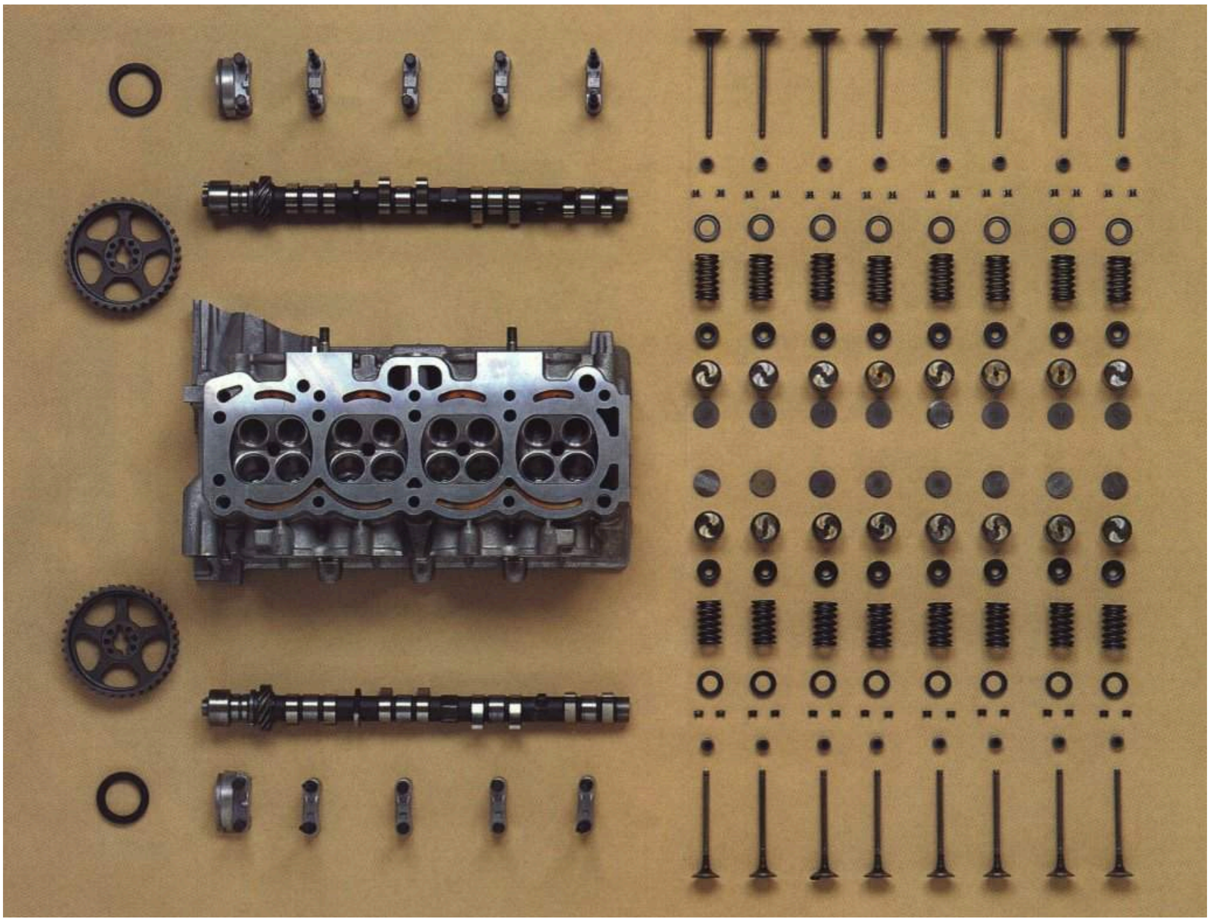
Above Cosworth BDA. Below 4AGE Formula Atlantic

“My 4A-GE revs to 10,000 RPM”

While this is possible consistently in a fully built racing engine, or a few short times with a standard engine, the 16v is well documented at failing at 9000 rpm without serious engine modifications to support it. The first point of failure are the rods, either the lower bolts on the rod cap will shear and shoot out of the block, or the wrist pins will seize and fail from lack of lubrication, destroying both the rod and piston.

20v engines can sustain high RPM for longer amounts of time, with Blacktop iterations capable of bursts to 10,000rpm with no rev limiter.
However at this amount of revs, the main crankshaft bearings will soon fail due to the oil pressure being too low in the crankcase. It's also worth noting the power and torque of the engine drops off considerably past 8200 rpm, with no performance benefit to revving this high.

Conclusion **FALSE**. The stock 16v engine internals cannot sustain 10k rpm or higher, are proven to fail well before and offer no performance gain past that RPM.

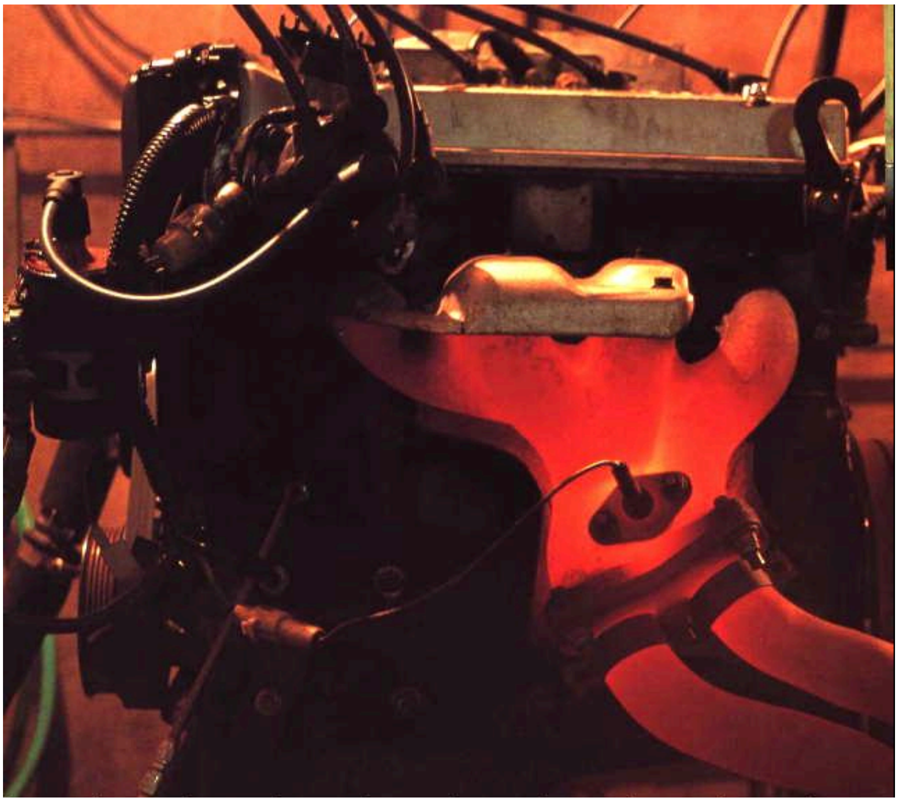


A 4A-GE 16 valve head completely disassembled

“My 4A-GE makes factory horsepower”

This is a difficult one to debunk. But let me explain:

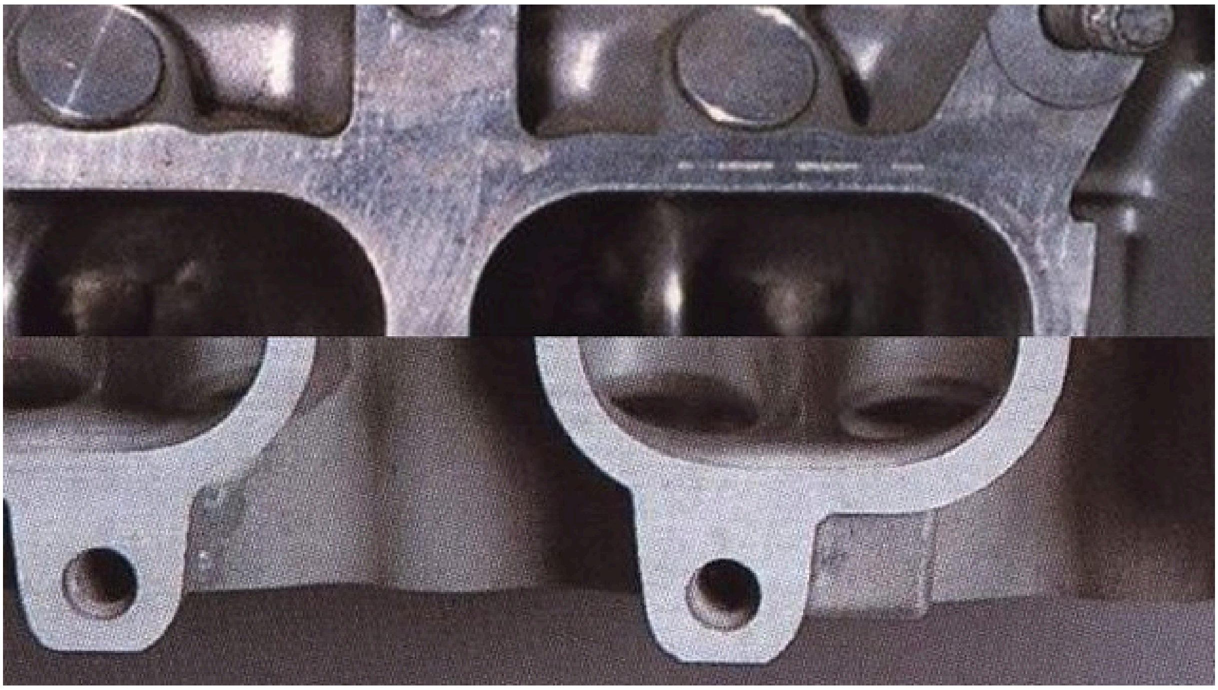
Back in the 90s and early 00s, Toyota would rate an engine's horsepower and torque figures together with the relevant vehicle statistics. In 1995 the 20 valve Blacktop 4A-GE reached a staggering 165hp. This was a common power figure at the time with the likes of Hondas B16 VTEC and Nissans SR16VE surpassing that.



However when these vehicles were measured on a dynamometer, the results were substantially less than the claimed factory HP. Results as little as 92hp were recorded for the USDM 4A-GE equipped SR-5 Corollas. So how can that be?

Toyota later admitted to measuring the engine performance on an *engine dyno*, not a rolling road. Furthermore, the engine had no external belt driven accessories, and was run on 100 octane fuel with no drivetrain losses or emission restrictions to account for.

Conclusion **FALSE**. While these are powerful numbers to quote, in the real world the 4A-GE made 10-15% less power than the official performance figures, straight from the factory. After adding a few decades of wear and tear, only a freshly rebuilt engine can claim to be close to the quoted horsepower figures from Toyota.



A photo showing the difference in size between bigport and smallport inlets.

4AGE EVOLUTION

Here we will cover the many variations of the 4A-G, from its birth in 1982 to retirement in 2000

It is worth noting that while they are commonly referred to as “bluetop”, “redtop” “silvertop” etc, that is a wildly inaccurate way of identifying the engine, for example a 1983 build 16 valve can be called a “blacktop” due to its black lettering!
In this instance we will refer to them by the size of the inlet ports, the ribs on the engine block and the number of valves.

Identifying features:

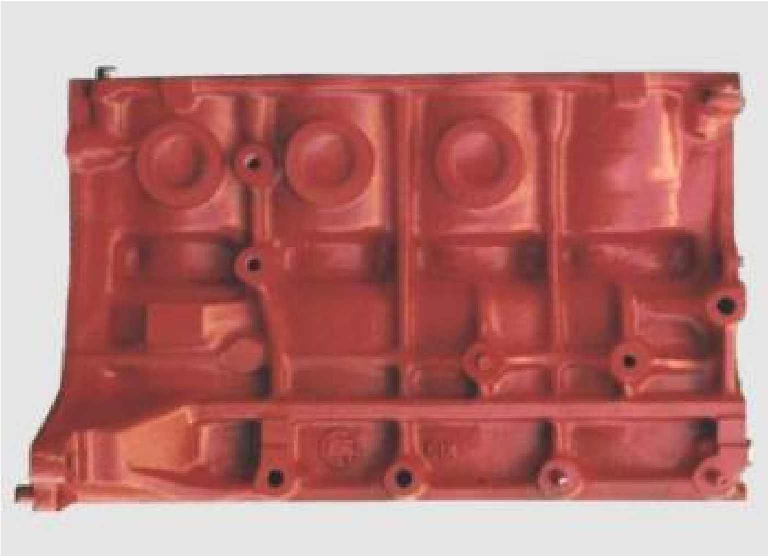
The 16 valve engine is easily recognized by some key differences.

-Bigport and Smallport head

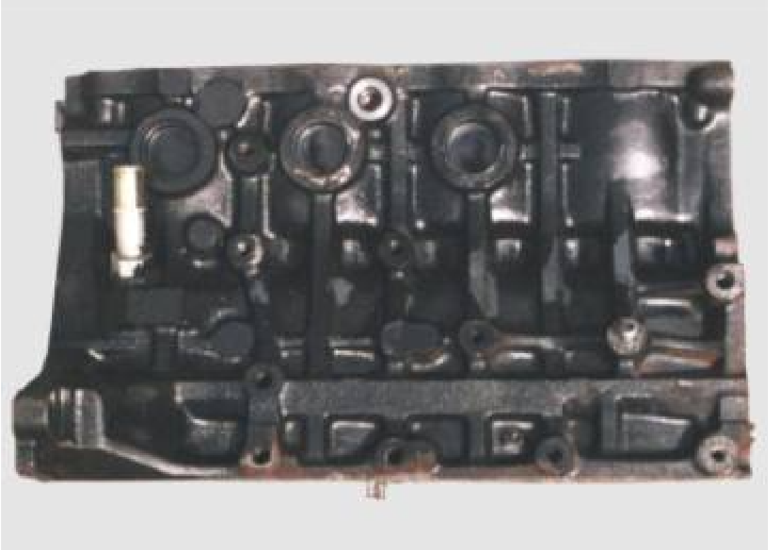
-The number of support ribs along the block

-The number of valves

These two photos below show the difference between the early 3 rib, and later 7 rib blocks.



The "ribs" refer to the additional structural support ribs cast into the block, to aid with strength and harmonic resistance.



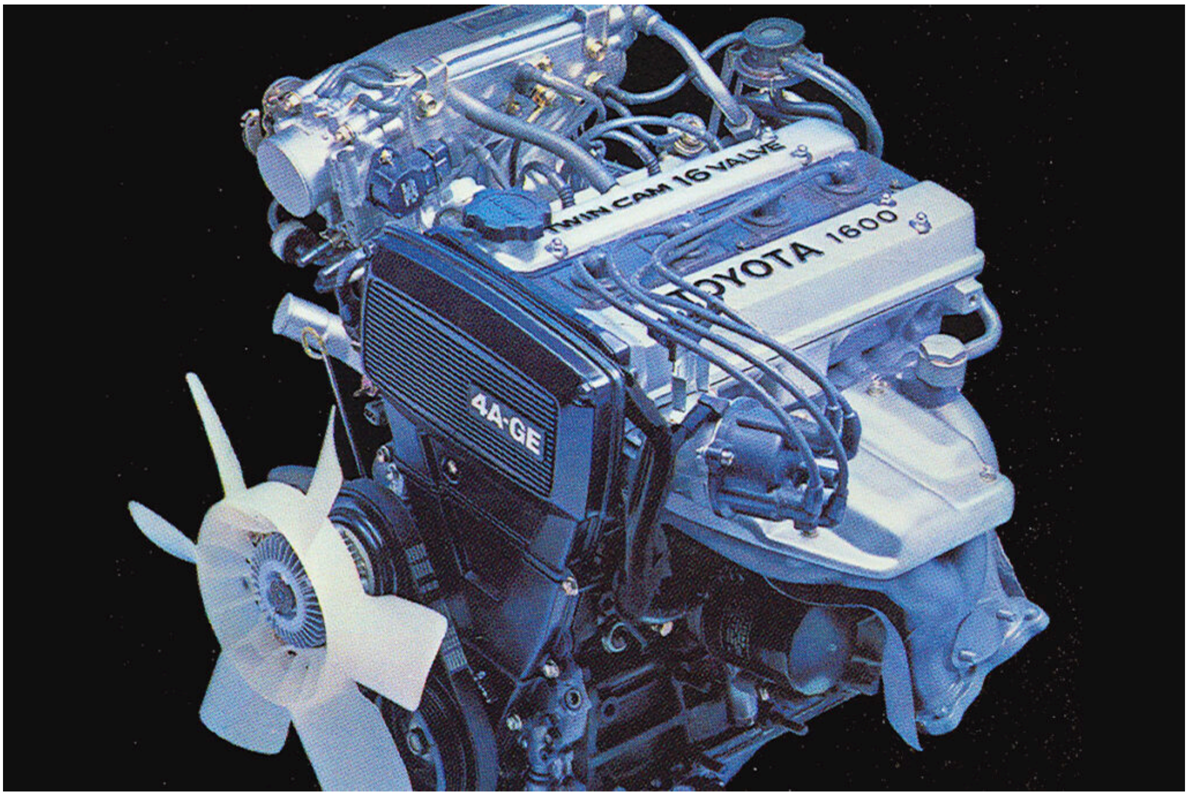
This is a later 7 rib from an AE92. Note the extra oil drain, to aid with cylinder head lubrication.

Pictured is a FWD TVIS "variable intake" manifold.
More on this below.

First generation 16 valve Bigport - 120hp

This was Toyota's first iteration of the 16v 4A-GE. It is widely disputed if this engine even exists, but there is sufficient evidence to show it does.
It is also the rarest, with a short build date from 1983- 1984. Identified by TVIS, 3 support ribs along the block, an 8 bolt “small” rod journal crankshaft and black lettering on the cam covers
Found in the early versions of the AE86 Corolla and AA63 Carina / Celica

Note- there is a misconception that this early engine shares its bottom end internals with the 3A-U, using a 6 bolt crank. I have verified this is untrue, as the part numbers from Toyotas EPC are entirely different for the crankshaft, rods, mains and pistons and block.
The only relation is the clutch assembly.



As this engine is extremely rare, finding good quality photos online can be difficult.
See the full black lettering above, instead of the later blue “16 valve” lettering

Second generation 16 valve Bigport (Bluetop)- 120hp

This was the second iteration of the 16v, with a build date from 1984-1986.
Still retaining the early 3 rib block and TVIS, engine airflow was measured by a manifold pressure sensor (MAP).
It used an early “small” 40mm rod journal crankshaft that was 700g lighter than the later versions. Compression was 9:4
There are no noticeable differences between this and the early bigport, except the cam lettering is blue, and the engine block part number was changed.

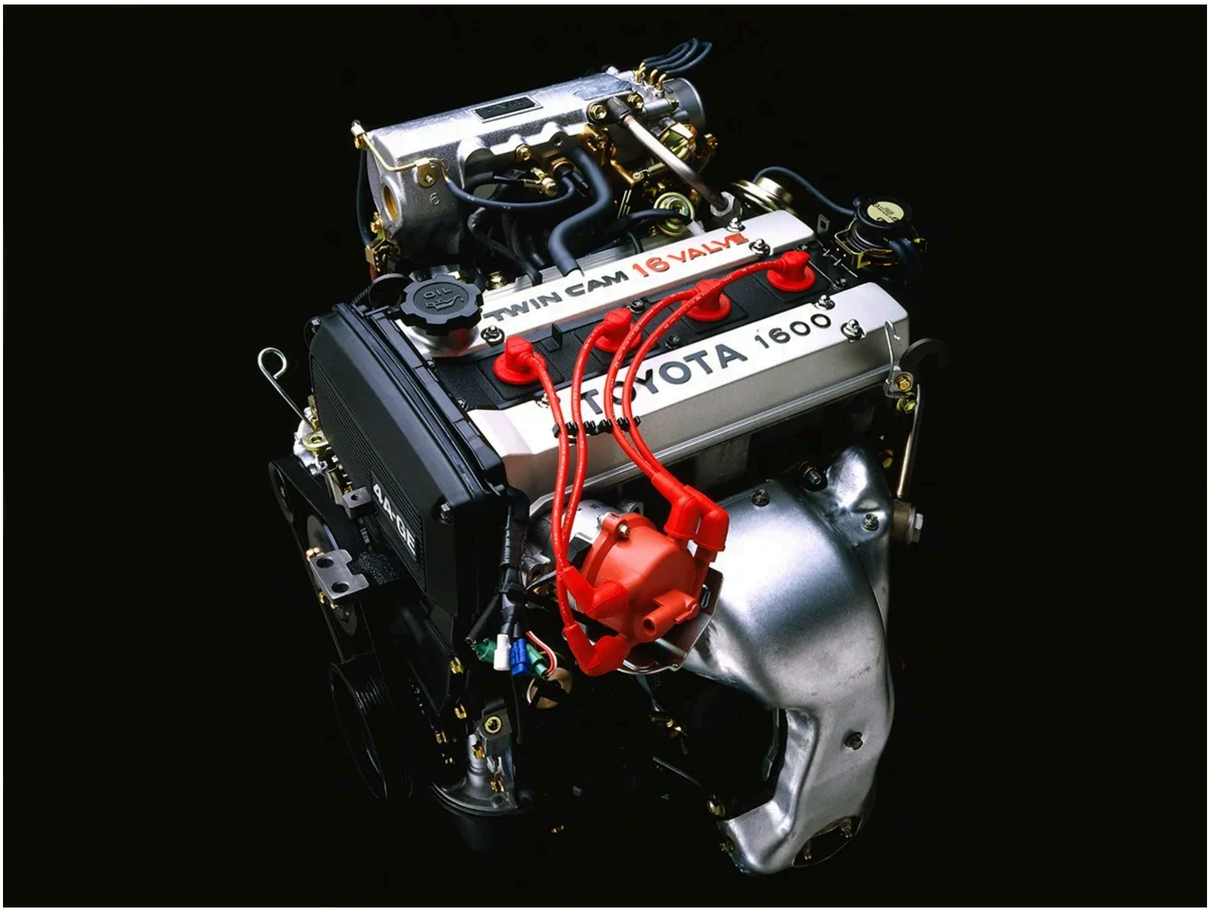
Found in the AE82 Sprinter / FX-GT, AT160 Carina, AA63 Celica, AT141 Corona, and early versions of the AE86 / AW11

Only milk should have a blue top

Third generation 16 valve Bigport (Redtop)- 118hp

This was the third and final iteration of the bigport. Build dates 1987- 1989
TVIS was kept, key differences were it gained a new 7 rib block, a new crankshaft with 42mm conrod journals (previously 40mm) and new conrods, these both were stronger but heavier than their previous counterparts.
JDM models retained MAP sensors, while others received AFM.
This was the final factory RWD configuration for the 4A-GE. Can be identified by red lettering on the cam covers.

Found in the early AE92 FX-GT / GTi / Levin / Trueno / Sprinter, AT171 Carina, and late variants of AW11 and AE86

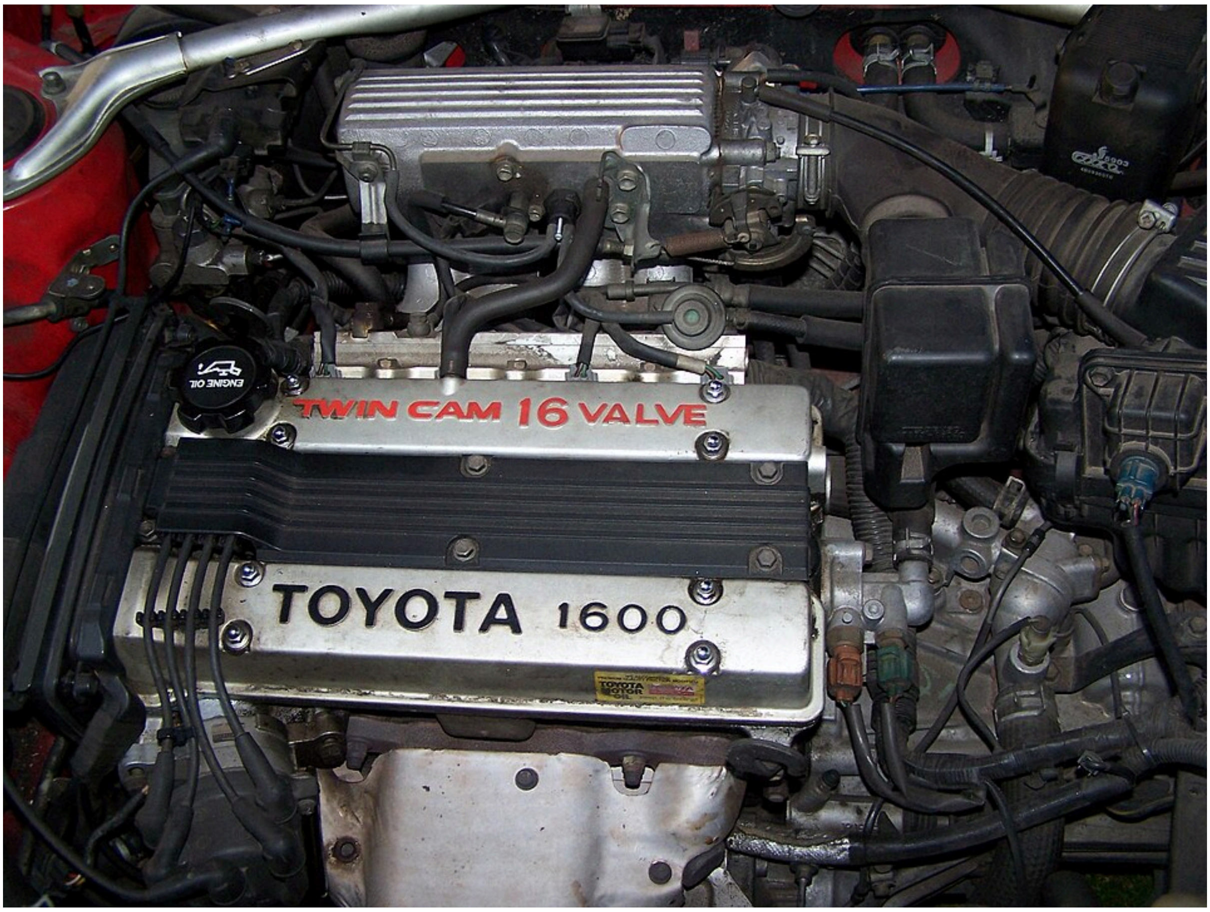


Note- there is evidence of some very late model bigports coming with the later 7 Rib block with oil squirters and a knock sensor. I am yet to verify this.

Fourth generation 16 valve Smallport 130hp

This was the final and highest output of the 16 valve. Build dates 1989-1991.
The head design was revised with smaller inlet ports and TVIS substituted with a new conventional four runner intake manifold. The cam duration was also reduced, and compression raised up to 10:3
The same 7 rib block was used from the late bigport, although the new variant gained oil squirters, lighter rods, higher comp pistons and a revised oil pump gear. The 42mm journal crankshaft was reused, now with a knock sensor.
Smallports are identifiable by a black finned valley cover, red / black lettering and lack of TVIS.

Found in the late model AE92 FX-GT / GTi / Levin / Sprinter and late AT171 Carina.



Note- some early smallports had a shallow spark plug valley cover, similar in design to a bigport.

Fifth Generation 20 valve Silvertop 158hp

Toyota now introduced a new 5 valve per cylinder head. Build dates 1991- 1995.
This new engine incorporated variable valve timing (VVT) on the inlet cam, and the valve angle was raised 10 degrees on both inlet and exhaust.
Compression was bumped up to 10:5.
A new inlet manifold was developed using a short runner intake manifold with throttle valve for each cylinder, feeding to a shared plenum. This setup allowed for a much higher air inlet speed and changed to AFM only.
Redline was up to 7600 rpm, it retained the same 7 rib block before, reusing the same 42mm crankshaft and rods but gaining higher compression pistons.
A factory 4-2-1 tubular exhaust header was fitted, replacing the previous cast design.
Silvertops are identifiable by a silver rounded cam cover, polished lettering, individual throttles with “4-Throttle” plenum and AFM.

Found in the AE101 Corolla, FX-GT, Levin, Sprinter, Trueno, Ceres, Marino and Carina

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Sixth Generation 20 valve Blacktop 165hp

The latest and final iteration of the 4A-GE. Build dates 1995-2000
While using the same 5 valve cylinder head as its predecessor, the head combustion chamber was modified for more squish area. Cam profiles were tweaked, and compression peaked at 11:1
It used the same VVT system, with the engagement point coming on lower in the rev range. Redline was raised to 8000 rpm.
The same individual throttle body concept was carried over, this time with a MAP sensor replacing the AFM. The throttles and plenum chamber grew in size, and exhaust ports opened up by 2mm.
Using the same 7 rib block and 42mm crankshaft combination as previous generations, the blacktop received unique super lightweight rods and high comp domed pistons, with a new revised high volume oil pump.
Rated at 98 octane minimum and making peak power at 7800 rpm, this was the final twincam after seventeen years of evolution.

Found in the AE101 BZ touring, AE111 Corolla / Levin / Trueno / Sprinter / Marino/ Ceres and Carib

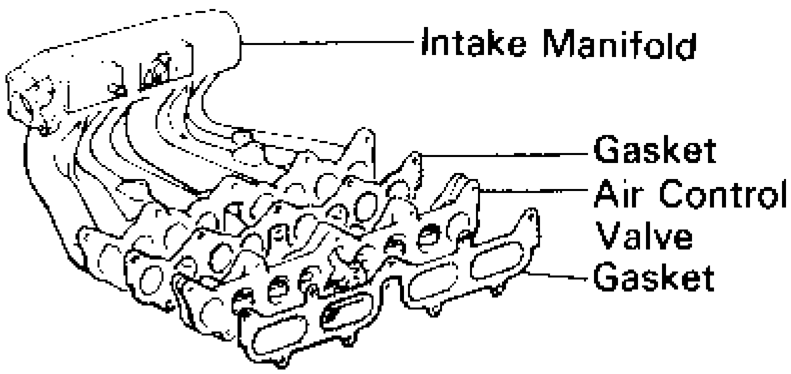
TOYOTA VARIABLE INDUCTION SYSTEM

Toyota developed an ingenious inlet manifold for the 4A-GE using variable throttle valves to regulate air intake speed at certain RPM.

Small displacement naturally aspirated engines normally have conservative sized inlet ports to increase intake air velocity, which is important to making torque. There is also a benefit to promote scavenging effects but that would take till next page to explain…

By comparison, the bigport inlets are on the large side for its engine capacity.
If the port is too large, the speed of the air at low rpm being sucked in is too low so the engine must work harder to build torque. Toyota rectified this in the smallport by narrowing the inlets, the smaller size would build volume quicker and pickup faster from the lower rev ranges.

The bigport used an unconventional manifold with eight intake runners, two for each cylinder.
One runner had a butterfly valve that could open or close depending on engine RPM. Below 4200, this valve was closed so the speed of the air being sucked into the cylinder was high, and the swirl effect enhanced (meaning low end torque was increased).
Above 4200, the valve opened so twice as much air volume could be harnessed per cylinder, allowing the engine to breathe more efficiently till redline.



The TVIS manifold came in both FWD and RWD engines, and can breathe efficiently up to 160hp. There is no benefit to removing the variable inlet valves until cams over 260 duration are fitted, or 8000rpm is exceeded.

Only bigport engines received TVIS. It is usually the easiest way of identifying a 16 valve.

Not all 16 valves are created equal…

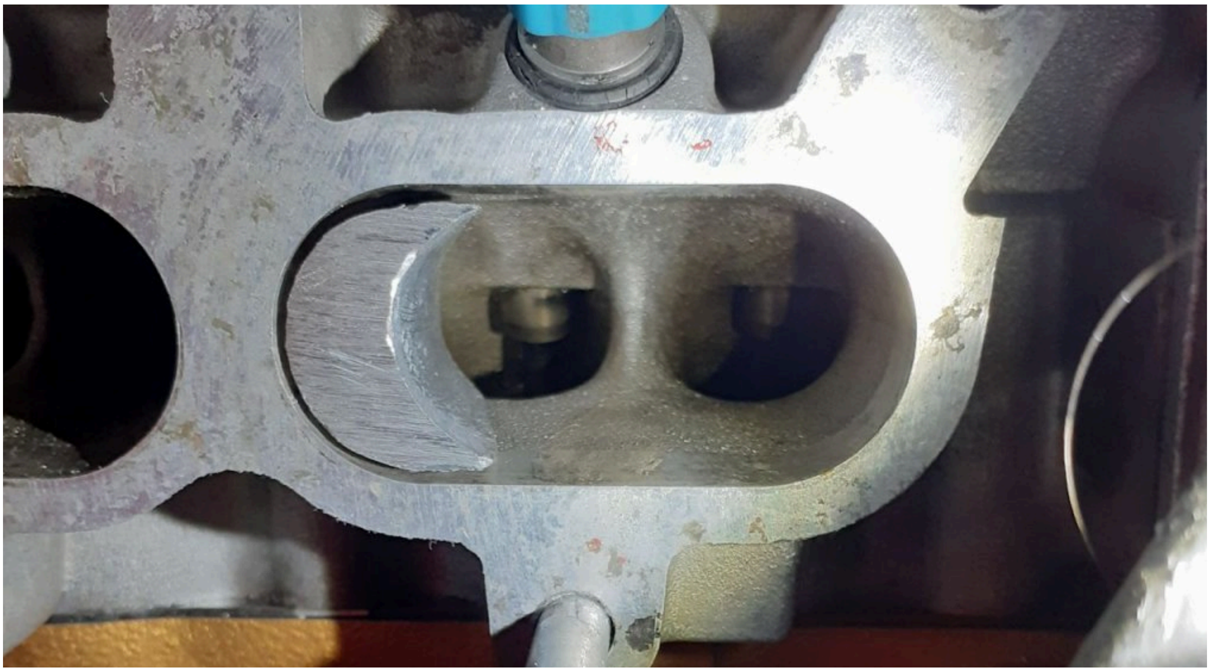
There is ongoing debate to this day over which 4A-G performs the best overall.
All have their failings and merits.

The early bigport head flows better, and the lower rotating assembly is lighter. Less reciprocating mass = faster engine speed.

The later bigport has a stronger bottom end, but the crank is heavier and it builds revs slower. It also has some minor (worse) changes to the inlet ports.
Smallports share the same block as the later bigport, using lighter rods and higher compression pistons.

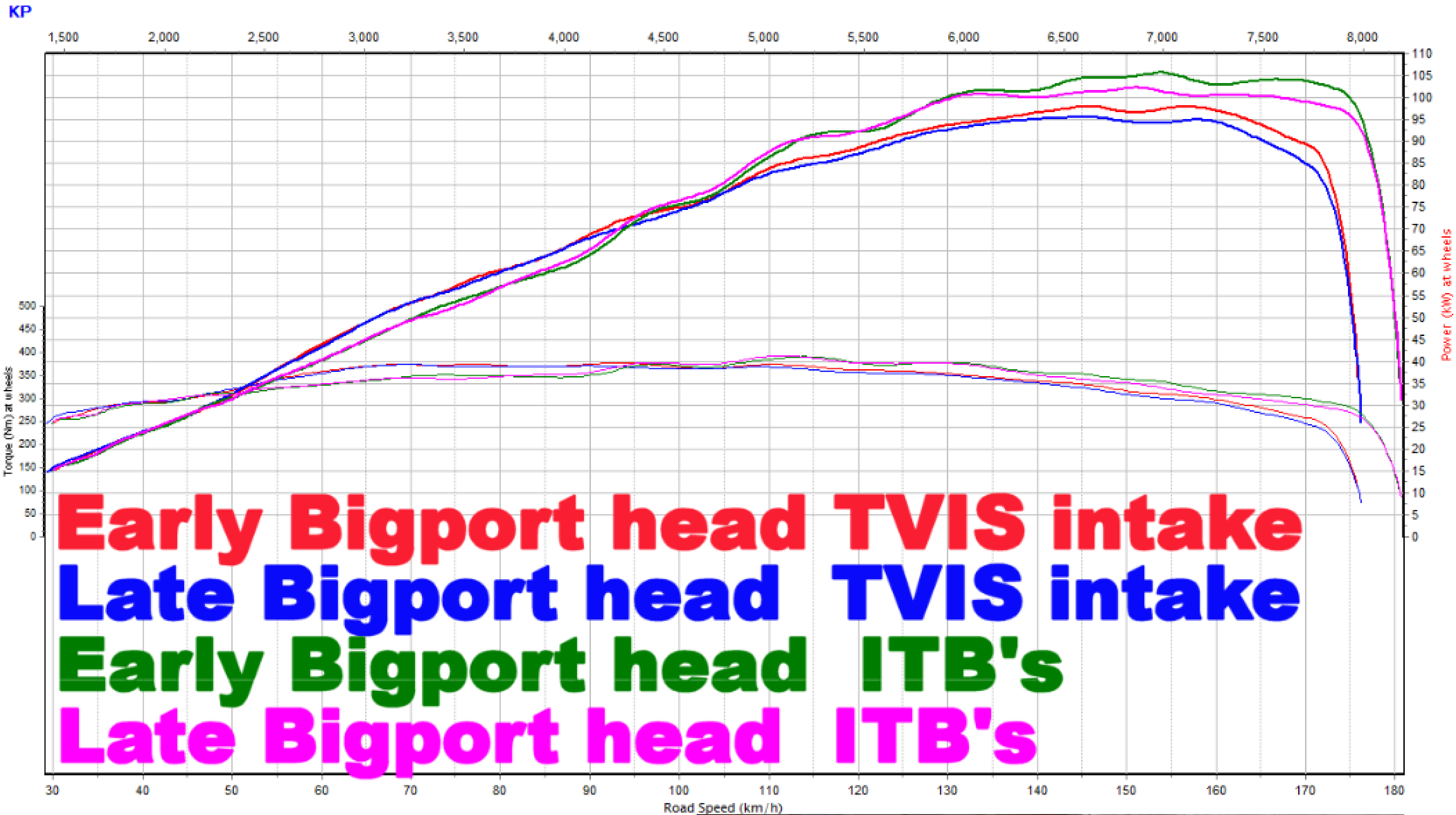
Some minor differences have been found over the years between the 16 valve heads.
The early bigport head is considered superior, with ITBs, cams and exhaust header modifications it will surpass the smallport for head flow efficiency.
In factory form, it's the opposite.
The late bigport head is considered the worst 16 valve head for flow and casting quality.

It is worth noting that only early 3 rib bigports came with 240 duration cams, instead of the later 232s. These give the engine more top end power.



A rare "medium port" head exclusive to the New Zealand market.

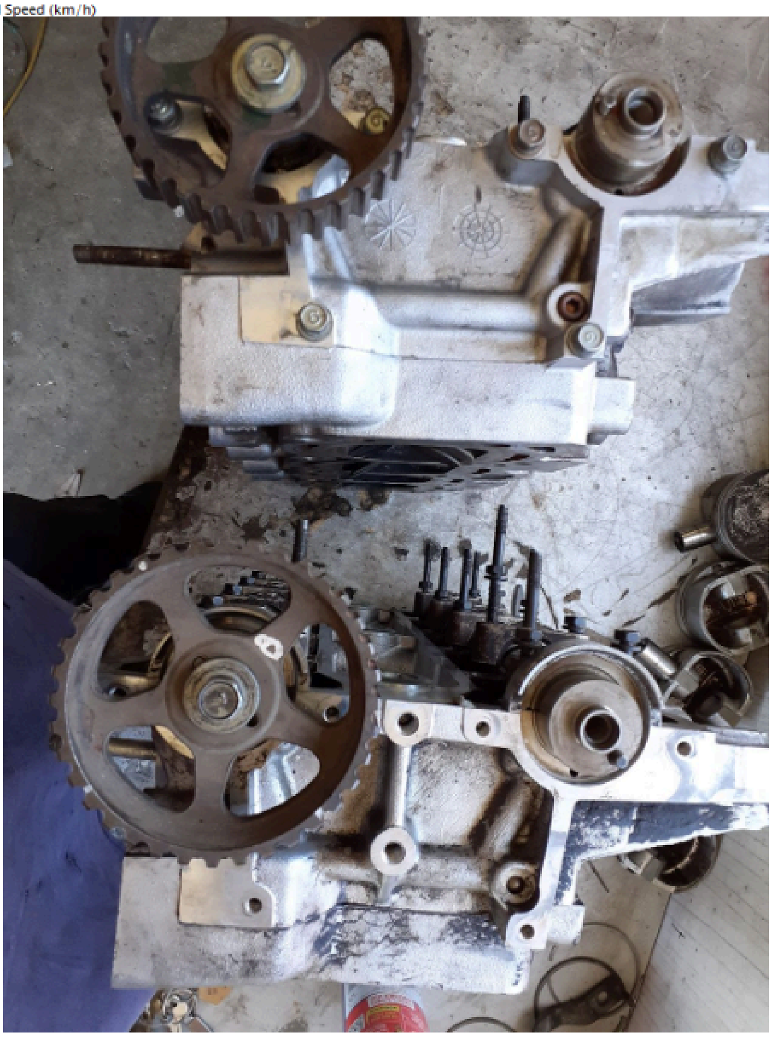
Below is a dyno graph showing the results of a 4A-G bigport comparison



The early and late bigport heads are identifiable by the holes (or lack of) in the top of the head casting, these are for a coolant hose bracket / splitter.

No holes - early head

Holes - late head



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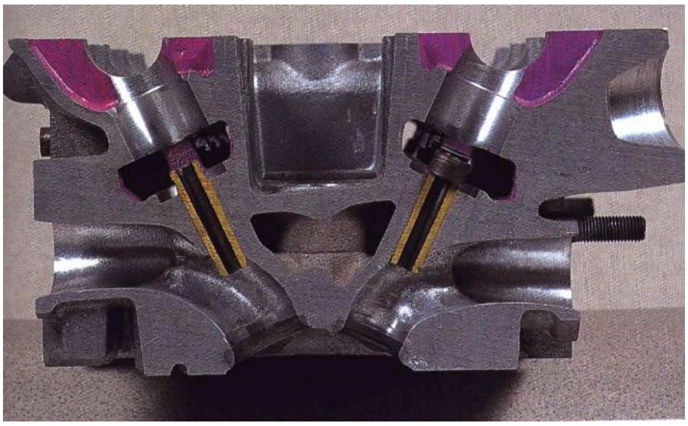
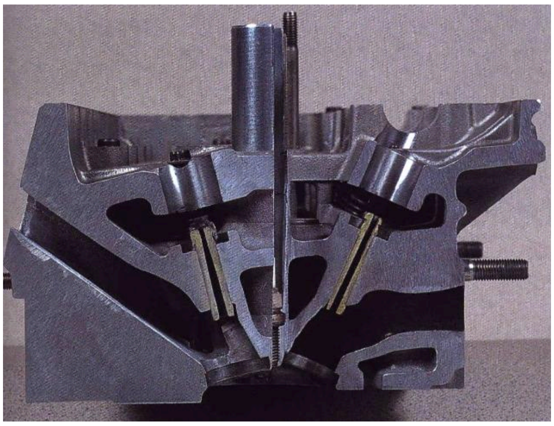
20 Valve heads

Both generations of the 20 valve head are well designed, and flow 60-90 cfm more than the previous 16 valve generation.
Yamaha modified the valve angle rake to 35 degrees, from the previous 45 degrees. Combined with the extra inlet valve, this greatly improved the inlet pathway with a more direct passageway to the combustion chamber.

Below left, a cross- sectioned 16 valve head, and right a 20 valve head. Note the difference in valve angle.

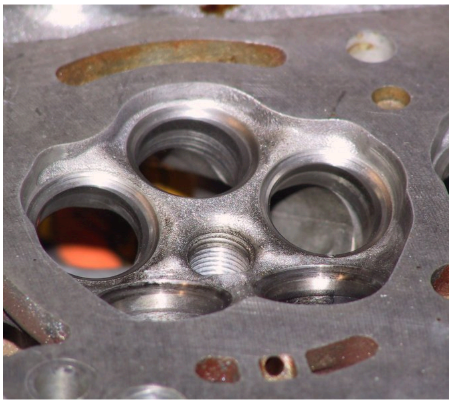




The downside to this is the extra intake valve decreases cam bucket size. Extreme high lift camshafts cannot be fitted, and for high performance applications the 16 valve is usually a better choice.

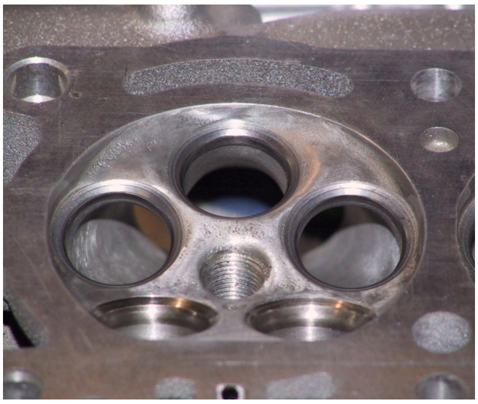
In stock form, the use of VVT greatly improves lower end torque and midrange, while retaining high intake cam lift.
The 20 valve is more linear in its power delivery, with blacktops becoming more peaky above 6500 rpm than its silvertop sister.

This is more evident in 16 valves, as they have a noticeable crossover when TVIS is activated, and smallports can be heard “coming on the cam” at 4600 rpm.



Silvertop combustion chamber on the left, and blacktop on the right.

Note the difference in squish area.



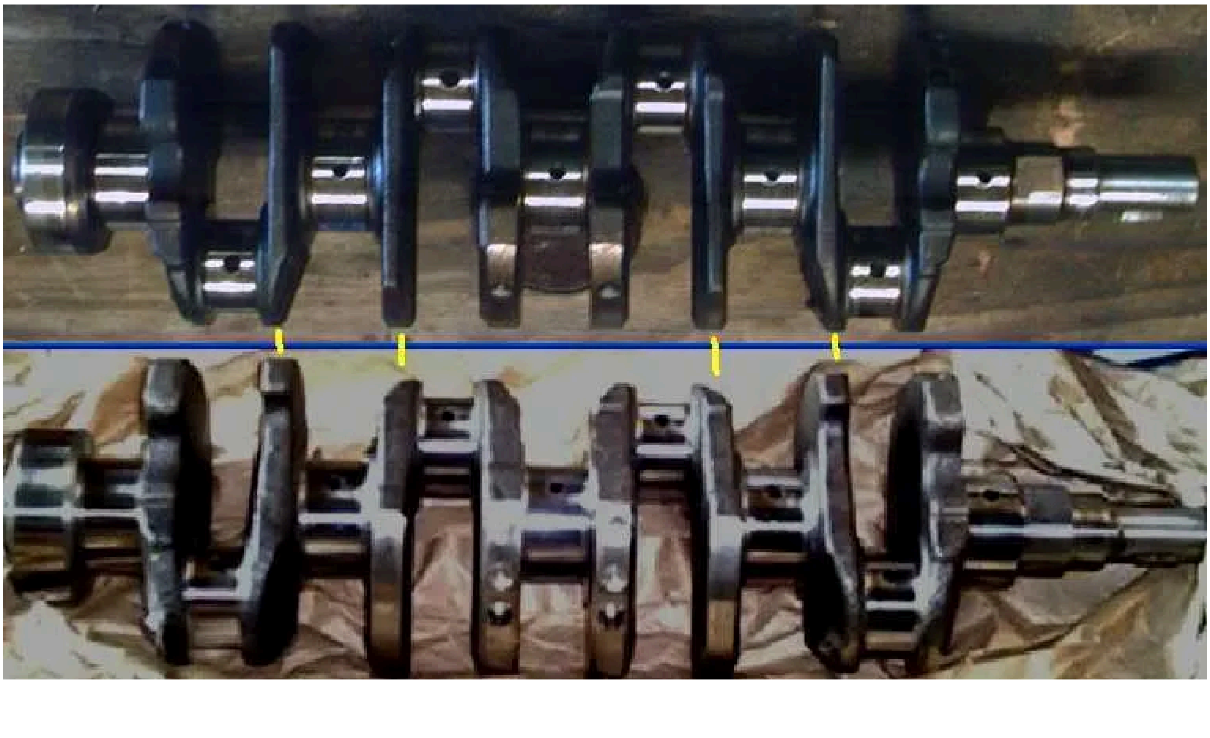
Cranking it

The factory 4A-G crank is a high quality forged carbon steel component with five main bearings and is fully counterbalanced. All use a 8- bolt flywheel mounting.

There are two variations of crankshaft used throughout the 4A-Gs lifespan. The early type has 40mm rod journals, with the later measuring at 42mm. No differences in strength or quality between the two have been found, and both are interchangeable between all versions of engine block.

The early crankshaft weighs 11kg with the later at 11.7kg. Both can reliably sustain a maximum of 9000rpm for short periods.

It is worth noting that early cranks have unequal counterweights between the #2 and #4 main bearings (photo below). There is evidence that these cranks "wobble" above 8500 rpm due to the unequal mass.
This cannot be balanced out, as it only occurs when load is applied by #2 and #3 pistons .



Conrods

Factory rods are a cast iron “I” beam design.

There were four variations of the conrods throughout the different generations.
A general rule of thumb is the early bigport rods use the early 40mm crank journal, and have an 18mm wrist pin. All wrist pins after this were 20mm.

Toyota’s quality control ensured all factory 4A-G rods are balanced within 2-5 grams of each other (this is important to reduce unwanted engine harmonics at high RPM).

Rod weights

- *Early bigport* 513 g
- *Late bigport* 528 g
- *Smallport & Silvertop* 509 g
- *Blacktop* 482 g

.
All factory rods have been proven to hold 150hp and 8000rpm reliably. The silvertop rods can be pushed further.

Pistons

The 4A-G used cast pistons throughout its production run. There are five different variations:

-Early bigport 9:4:1 CR (18mm)

-Late bigport 9:4:1 CR (20mm)

-Smallport 10:3:1 CR

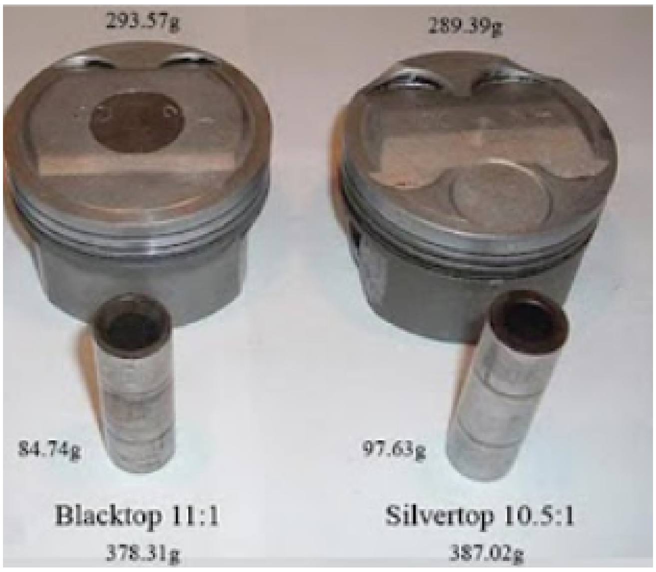
-Silvertop 10:5:1 CR

-Blacktop 11:1:1 CR

Note- the later 5 valve pistons have an additional seat cutout in the piston dome for the fifth intake valve, they must not be used with a 4 valve head.

Smallport piston pictured above

Early variations of the bigport used a 18mm pressed wrist pin. Toyota changed to a 20mm floating pin design as the RPM limit increased.



Note the difference in dome shape between the two. This is synonymous with the shape of the combustion chamber.

Factory 4A-G pistons are considered reliable up to 160 hp.

Late bigport pistons suffered from a high rate of oil control ring wear, leading to burning and eventual smoke. This tends to happen over time when the engine is not warmed up properly before hard usage.

Camshafts and Valves

The 4A-G uses a modern “shim over bucket” design, where the cam lobe presses directly down onto the valve, instead of a conventional rocker arm or hydraulic lifter design. It's proven to be incredibly reliable, with little to no adjustment needed. Most high revving production engines operate on a similar system.

- Early bigport	240 duration	7.5mm lift
- Late bigport / smallport	232 duration	7.1mm lift
- Silvertop	244 duration	8.1mm lift
- Blacktop	250 duration	8.5mm lift

Note- in this instance, lift is only measured on the intake cam

Standard 4A-G valve springs are rated to around 8000rpm. With prolonged use at these revs, they will lose tension and the valves will “float”.

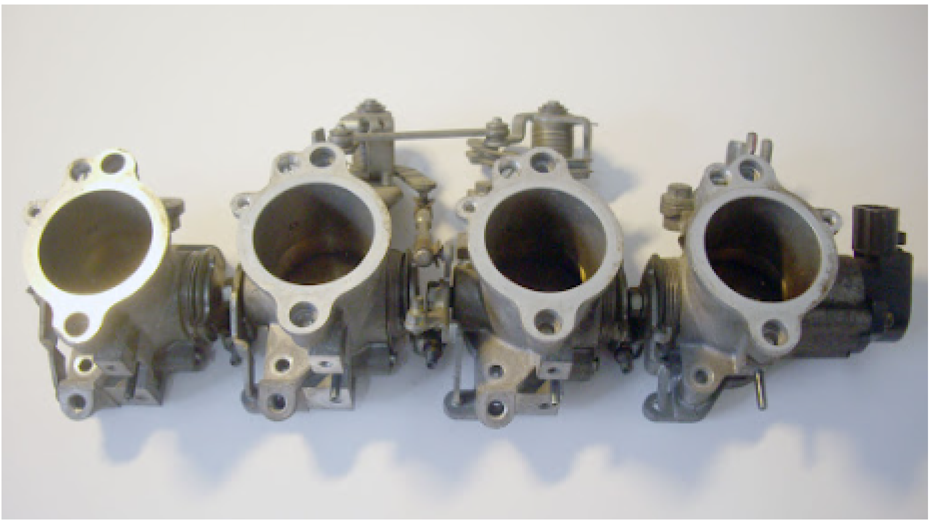
Factory 232 cams max at around 150hp, 240’s can potentially reach 160hp.

For high lift cams with a duration of 264 degrees or over, higher tension valve springs are highly recommended. More than 9mm of valve lift will need modification to an “under bucket” shim, or the standard design shim on top of the bucket can be spat out at high rpm.

For cams above 272 duration, standalone engine management must be fitted as the factory ECU cannot cope at idle.

It is worth noting that 50% of power gains from the 4A-G can be achieved by a good camshaft setup, this is further enhanced with the use of fine-tuning using a pair of adjustable cam gears

4-THROTTLE



In 1991 Toyota fitted the new Silvertop 4A-GE with a revolutionary individual throttle body intake manifold, a first for a mass production engine.
Up until that point, ITBs were reserved for ultra high performance homologation specials usually of European origin.

This factory manifold has proven to be a valuable upgrade for all 16 valve generations of engine, and gain power all the way to 180hp.

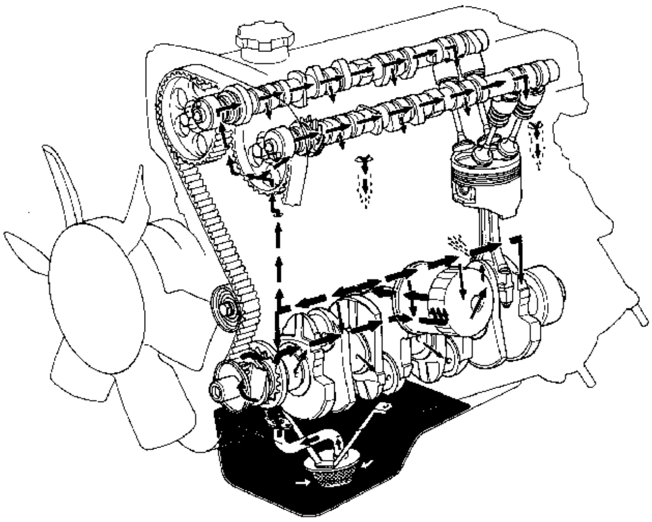
There are minor differences between the blacktop and silvertop manifolds. The blacktop inlet bore is wider, and uses a MAP sensor so open throttles can be used with no plenum. This is possible on the factory ECU, but not on the silvertop AFM setup.

These throttles can be utilised on the 16 valve engine with the addition of an adaptor plate intake manifold. Standalone ECU engine management must be used.

Oil pumps

The 4A-GE internal lubrication system is very reliable and generally gives little trouble. The primary engine failures are lack of lubrication to the main crankshaft bearings from over revving.

The early bigports were designed with only one oil feed and drain cast in the head. It sat offset, and on fast left turns the oil could pool in the intake cam girdle and starve the bottom end, as well as filling the intake with oil…



This was rectified in the late bigport with the addition of a secondary oil drain that also fed the piston oil squirters.

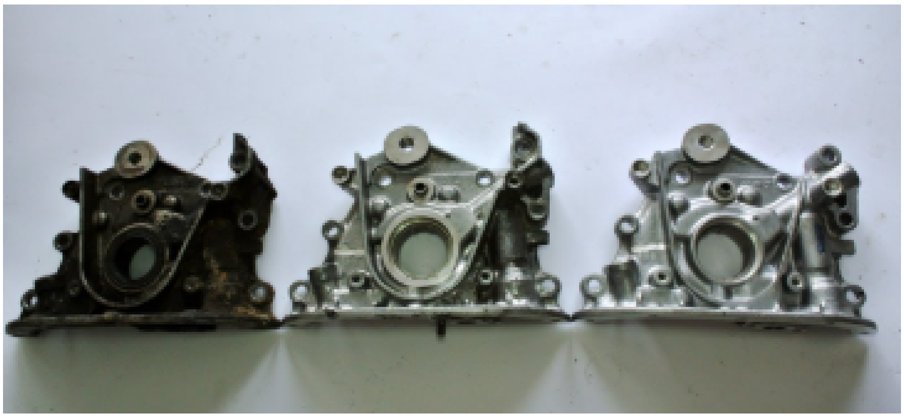
The oil pump is of AISIN make and is generally very reliable. There are three types, and two are interchangeable.

- Early bigport, these have rounded teeth and flow the least, they also have no factory oil cooler incorporated.

- Late bigport - silvertop, these have jagged teeth and use a higher pressure relief spring for the oil squirters and additional oil drain.

- Blacktop, these have the highest volume and an additional bolt for the hydraulic timing belt tensioner, unique to the engine.

While all oil pumps can reliably sustain 8000 rpm, the early 16 valve pumps are prone to cracking internally. Changing to a silvertop pump is a common modification for higher performance.



Fuelling

The 4A-G of all generations used a Bosch L-Jetronic EFI system, built under licence by Nippondenso.

This system used an oxygen sensor and MAP or AFM sensor in conjunction with the engine ECU to determine air and fuel values, and effectively meter the ratio in a closed loop circuit.

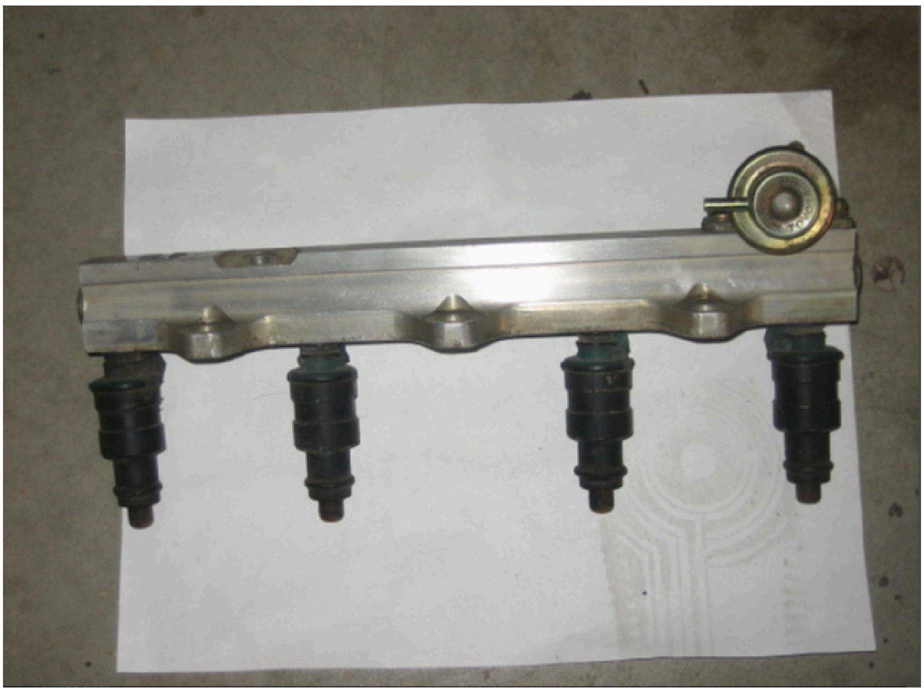
All generations have a diagnostics port that can give basic (pre OBD II) information of fault codes logged by the ecu. These codes are translatable in the technical index at the end.

. **Injector size and impedance**

- Early bigport	182cc	1ohm	Top feed
- Late bigport	182cc	1ohm	Top feed
- Smallport	235cc	2ohm	Top feed
- Silvertop	295cc	2ohm	Side feed
- Blacktop	295cc	2ohm	Side feed

All 16 valve injectors can be interchanged with each other, although the 235cc smallport must be used with the matching ECU, this is because the impedance and timing is higher. The 235 are generally considered the superior factory 16 valve injectors due to the finer spray pattern.

Factory 182cc - 232cc injectors can be used up to 8000 rpm or 150hp.



Exhausts

The factory 4A-G 16 valve uses a cast iron “log” design. These are found on both RWD and FWD engines.
Later 20 valves utilised a OEM tubular “extractor” type manifold. These manifolds are considered superior, but were only available on a FWD configuration.

The later 20 valve manifold cannot be used with a 16 valve without modification. The outermost bolt spacing is different, and the flange must have new holes drilled and notched.

The 20 valve manifolds are quality item and can flow adequately up to 180 hp.

20 valve manifolds underwent two revisions, the later blacktop saw the outlet holes widened 2mm and the lower collector pipe opened up to allow a superior scavenging effect at high RPM.

Note- the early 16 valve cast manifolds are prone to cracking between #2 and #3 cylinders over years of heat cycling.

Pictured left, 16 valve exhaust

Pictured right, 20 valve exhaust

Valve covers, sumps and external accessories

The 16 valve engine used a two piece valve cover, one for each camshaft. However the downside to this is only one cover has a vent hose for crankcase ventilation, and only one oil baffle.

A popular mod is to run two oil cap covers, doubling the crankcase ventilation.

By comparison, a 20 valve cover is one piece, has a superior baffle system and two venting ports. All covers are interchangeable between their respective heads.

4A-G sumps are cast steel. RWD and FWD sumps are different shapes, however both pickups are in the same place. 20 valve sumps have more baffling, higher clearance to the road surface and are lighter.
Note- 20 valve sumps have a different bolt pattern than 16 valves, and must be used with a 20 valve 7 rib block.

Waterpumps

The 4A-G water pump is driven externally by the drive belt and sits behind the engine's cambelt. There are 3 variations:

- **16 valve FWD.** These are the most common, and come on all versions of the 16 valve engine, and silvertop. They are a two piece design, and very reliable.

- **16 valve RWD.** These are the same as the FWD pumps, but have a longer “snout” to compensate for the driven engine cooling fan on the front of the engine. They are not interchangeable.

- **20 valve blacktop.** These are a different shape to allow clearance for the hydraulic cambelt tensioner.

Flywheels

All Variants used cast steel flywheels with press fit ring gears. They all share the same 8-bolt mounting, however there are a few differences in size and weight throughout the years.

- Early bigport	200mm	8.0 KG
- Late bigport	212mm	7.8 KG
- Silvertop/ Smallport	212mm	6.9 KG
- Blacktop	212mm	5.9 KG

Note- all flywheels are interchangeable between all engines, provided the clutch assembly is changed to the correct size.

Headgaskets

The 4A-G headgasket is a standard composite graphite based affair.
Factory height of 1.2mm.
16 valve and 20 valve headgaskets differ in design, with the latter having wider coolant jacket entry, and a different shape head feed oil port.
They are not interchangeable.

A TRD 0.8mm headgasket is a cheap and reliable way of raising compression

Above- 20 valve, Below 16 valve. Not the difference in oil drain and coolant port sizing.

Other relevant stuff

Crank pulleys: These are interchangeable, 16 valves use a twin row rubber harmonic damper while the blacktop uses an internal single row that sits closer to the engine.
The 16 valve pulley will not fit on a 20 valve blacktop timing cover, and vice versa.

Timing belts: 16 valve belts are all interchangeable and have 113T. The 20 valve belts are 111T. The Blacktop belt is unique in using a finer tooth belt and is narrower to accommodate the longer crank pulley.

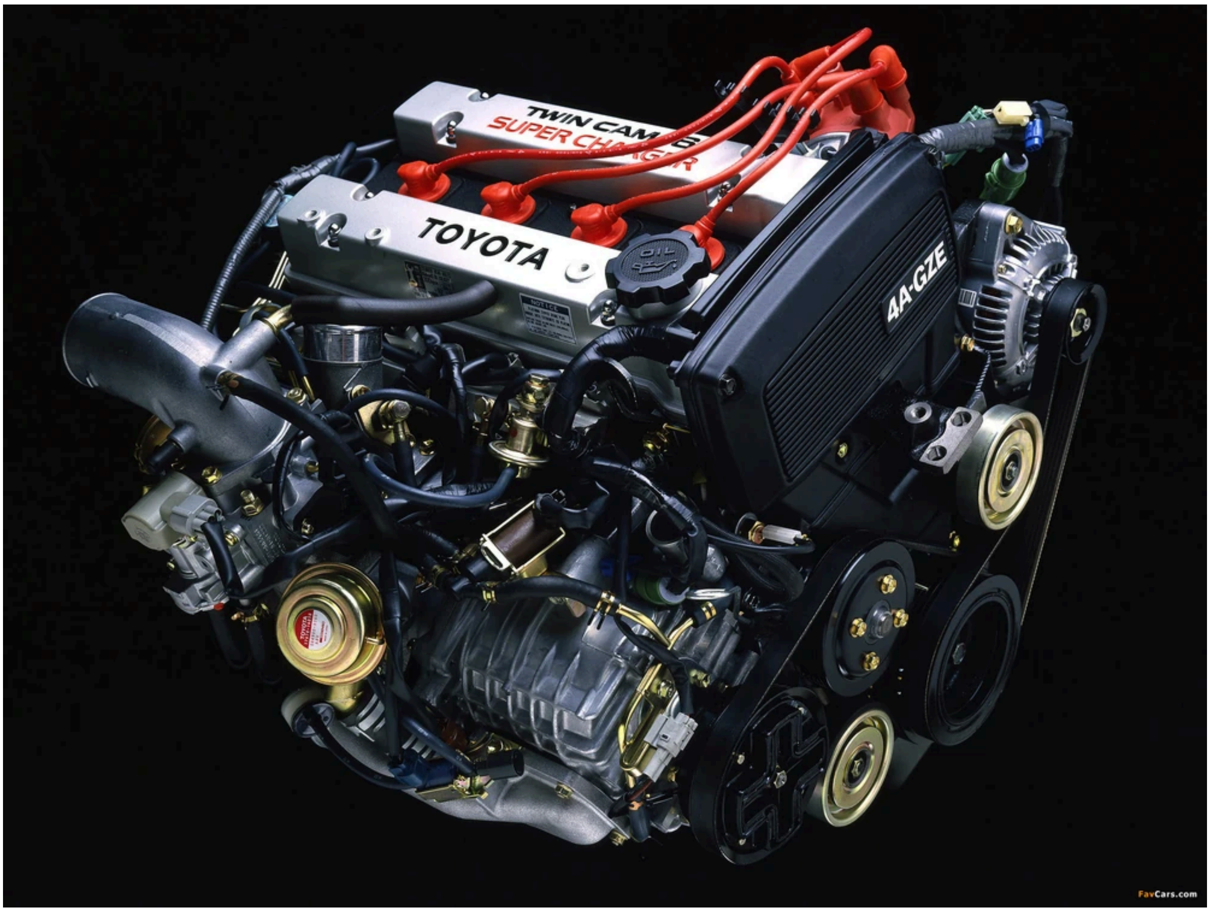
Starter motors: These come in three types, some interchangeable. Early bigports came with a 0.9kw starter with a cone shaped head over the gear and armature. Later bigports and smallports were 1.1kw, with no cone.
Both versions of the 20 valve had a more powerful 1.1kw reduction gear type.
The last two are interchangeable, but the early bigport with an exhaust side mounted starter must use the early type cone design.

Cam gears: All versions of 16 valve cam gears are interchangeable.
20 valve exhaust side gears are unique to their respective engines, as are the VVT pulleys.

Pictured above, a high performance turbocharged 4A-G blacktop.

TWINCAM FORCED INDUCTION

In order to simplify this guide, I have created a separate page for the 4A-GZE.



At the coming of 1986, Toyota started production of a special supercharged version of its proven 1.6. This was dubbed the 4A-GZE.
In Toyota engine nomenclature, Z is the character for supercharging, which had already been used to great extent in the 1G-GZE engine a year prior.

This engine had a belt driven roots type blower compressing air into the cylinders through an intercooler. The supercharger was Toyota's own design, named the SC12 (later higher volume blowers were called the SC14).

A special characteristic of this blower was it used an electromagnetic clutched pulley on the compressor- when engine load was low, the pulley would freewheel not turning the blades. Under load it would engage, giving the engine a noticeable performance boost. This was to offset fuel consumption.

The 4A-GZE had three variations throughout its 9 year lifespan.

First gen bigport- Build date 1986- 1989
Utilising a 16 valve head, and early 7 rib block without oil squirters. It used an identical crankshaft and rod assembly to the standard 4A-G, but gained semi forged lower compression 8:0 pistons. These were AFM only.

Found in the early AW11 SC and later AE92 GTz

Second gen bigport- Build date 1989- 1991
While the engine remained mostly the same, the GZE now gained higher compression 8:9 pistons with ceramic coated tops.
The supercharger pulley size was reduced, and boost raised to 10psi. A MAP sensor was introduced to replace the AFM.

Found in the later AW11 SC and AE92 GTz

Third gen smallport- Build date 1991- 1995
The final GZE now received the latest 16 valve smallport head to increase overall engine response. The later 7 rib block was also used, with oil squirters to increase piston skirt lubrication. Boost remained the same at 10psi, and fuelling system tuned further for a total output of 170 HP

Found in the AE101 Trueno / Levin GTz

There is a common misconception that the 4A-GZE engine internals are stronger than the standard naturally aspirated version.

The only key difference is the pistons were changed to a lower compression semi forged design. The rods and crank remained unchanged.

Note- this is a good explanation to why the late bigport engine moved to a heavier rotating assembly in 1986 using the larger 42mm crank and thicker rods. Toyota were preparing the engine for boost, something that the early bigport internals would not handle.

The GZE engine can be boosted up to 250 hp without any serious internal modifications.
TRD and HKS developed an underdrive pulley for the SC12, boost can be raised up to 12psi.

However the supercharger blades must not exceed 9000rpm, or the teflon seals on the tips will generate too much heat and melt.

Pictured is a very rare HKS supercharger kit for the GZE, with up to 220 hp on tap.
Note the larger intercooler in the factory position.

Technical Index

Below is a collection of specifications and diagnostic information .

4A-GEU/GELU Technical Specifications OEM

	4A-GEU	4A-GEU	4A-GELU	4A-GELU	4A-GELU	4A-GLEU
Application	AE86 (84-85)	(AE86 86-87, AW11)	AE92 (88-89)	AE92 (90-91)	AE101 Japan (92-95)	AE111 Japan (96-2000)
General	DOHC Belt	DOHC Belt	DOHC Belt	DOHC Belt	DOHC Belt	DOHC Belt
Valves per Cylinder	4	4	4	4	5	5
Capacity	1587cc	1587cc	1587cc	1587cc	1587cc	1587cc
Bore x Stroke	81.0 x 77.0	81.0 x 77.0	81.0 x 77.0	81.0 x 77.0	81.0 x 77.0	81.0 x 77.0
Compression Ratio	9.4	9.4	9.4	10.3	10.5	11
Max power (hp)	130@6600 JIS*	130@6600 JIS*	120 @6600 JIS*	140 @7200 JIS*	160 @7400 JIS*	165 @7800 JIS*
Max torque (kg/cm)	15.2@5200*	15.2@5200*	14.5 @5200*	15.0 @6000*	16.5 @5200*	16.5 @5600*
Dry Weight	123	123	126			
Camshaft Lift IN/EX	7.56/7.56	7.56/7.56	7.56/7.56	7.1/7.1	7.97/7.60	8.20/7.60
Cylinder Head Construction						polished port
Piston Pin	18mm	18mm	18mm	20mm	20mm	20mm
Piston Skirt	slit type	slit type	slit type	slit type	solid	solid

Fuel Pressure Regulator	2.55kg/cm2	2.55kg/cm2	2.55 kg/cm2	2.9 kg/cm2	2.55 kg/cm2	2.55 kg/cm2
Fuel Pump Capacity						
OEM Spark Plug	BCPR5EP11	BCPR5EP11	BCPR5EP11	BKR6EP8	BKR6EP11	BKR6EP11
Misc.	TVIS 8 port	TVIS 8 port	TVIS 8 port	4 port	Indiv. Throttle, VVT	light flywheel VVT

DIAGNOSTIC CODES (TCCS ECU w/ Air Flow Meter)

Code No.	Number of CHECK ENGINE blinks	System	Diagnosis	Trouble area	See page
–	ON OFF FI1401	Normal	This appears when none of the other codes (12 thru 51) are identified.	–	–
12	FI1389	RPM signal	No NE, G signal to ECU within several seconds after engine is cranked.	1. Distributor circuit 2. Distributor 3. Starter signal circuit 4. ECU	IG-18
13	FI1390	RPM signal	No NE signal to ECU within several seconds after engine reaches 1,500 rpm.	Same as 12, above.	
14	FI1391	Ignition signal	No signal from igniter 4 – 5 times in succession.	1. Igniter circuit (+B, IGT, IGF) 2. Igniter 3. ECU	FI-54
21	FI1400	Oxygen sensor signal	Oxygen sensor signal output decreases.	1. Oxygen sensor circuit 2. Oxygen sensor 3. ECU	–
22	FI1392	Water temp. sensor signal	Open or short circuit in water temp. sensor signal (THW).	1. Water temp. sensor circuit 2. Water temp. sensor 3. ECU	FI-63
24	FI1611	Intake air temp. sensor signal	Open or short circuit in intake air temp. sensor signal (THA).	1. Intake air temp. sensor circuit 2. Intake air temp. sensor 3. ECU	FI-62
25	FI2562	Lean signal	Oxygen sensor signal continues to indicate a lean condition.	1. Injector 2. Air flow meter 3. Water temp. sensor 4. Intake air temp. sensor 5. Oxygen sensor	–
26	FI2563	Rich signal	Oxygen sensor signal continues to indicate a rich condition.	Same as 25, above.	–
31		Air flow meter signal	• Open circuit in VC, VS, VB or E2. • Short circuit in VC	1. Air flow meter circuit 2. Air flow meter 3. ECU	

Engine model	Factory Quoted C.R	+0.8mm head gasket	+7A bottom end
16V Big-port	9.4	9.8	*N/A
16V Small-port	10.3	10.8	11.3
20V Silver	10.5	11	11.5
20V Black	11	11.5	12
4AGZE early	8.5	8.8	*N/A
4AGZE late	8.9	9.3	9.8

Duration	Lift	Intake opening	Exhaust opening	Comments
232°	7.1mm	8°BTDC	47°BBDC	Stock 4AG(Z)EU used on 90~91 Hi-comp. AE92 and supercharged AW11. P/N Intake 13501-16030. Ex. 13502-16020, Good turbo cam. Keeps exhaust pressures high without blowing back though intake manifold.
240°	7.56mm	9°BTDC (Stock - max lift @ 111°)	51°BBDC (Stock - max lift @ 111°)	Stock 4AGEU used on AE86 and AW11. P/N Intake 13501-16010. Ex. 13502-16010. Some have found good power setting the maximum lobe lift for the exhaust at 100°BTDC and intake at 100°ATDC. For more bottom end power retard the exhaust 4° and advance the intake 3°. For more top end, advance intake 4°and exhaust 3° from stock settings.

Thanks for reading!